NMB SPLICE-SLEEVE SYSTEM

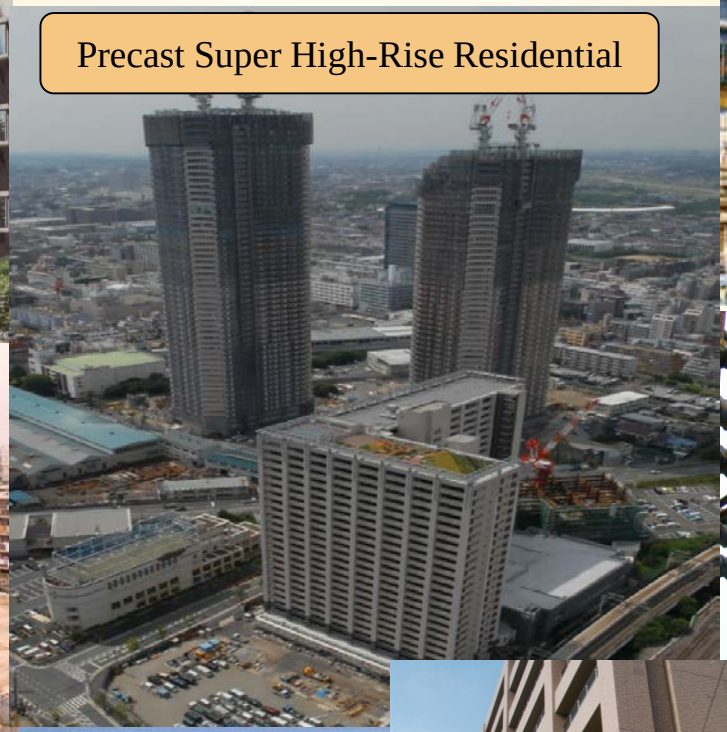
GROUTING OPERATION

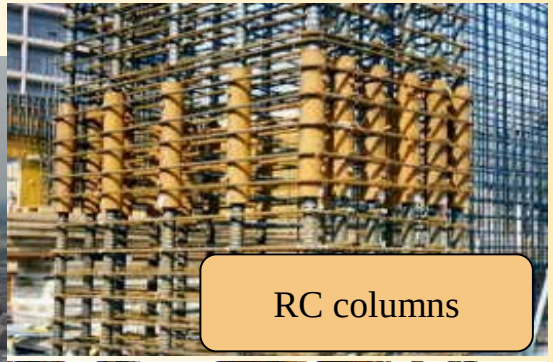
SPLICE SLEEVE NORTH AMERICA, INC.

APPLICATIONS

Mid-Rise Wall Precast

Precast Super High-Rise Residential



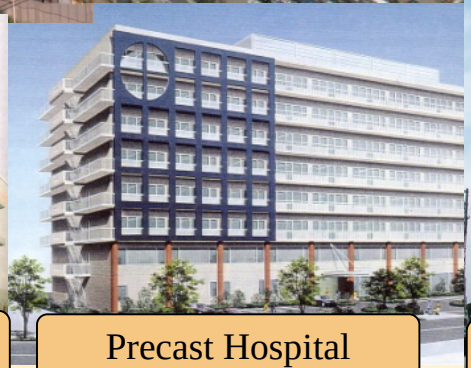


RC columns

Precast Beams

High-Rise Wall Precast

Precast Distribution Warehouse



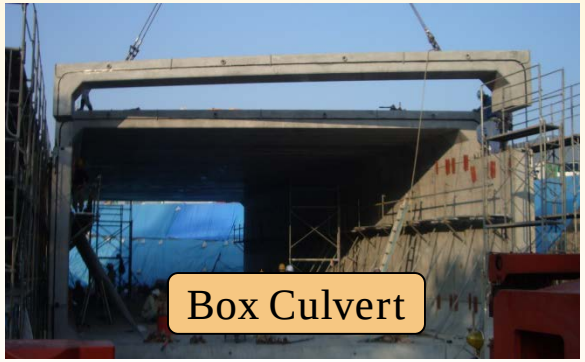
Precast Hospital

Seismic Reinforcement

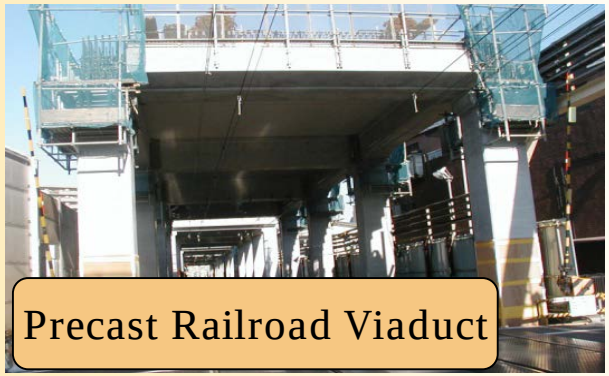
SRC Structure

APPLICATIONS

Railroad RC Pile


Box Culvert

Bridge-Caisson Pile


Precast Railroad Viaduct

Arch Culvert

Bridge -Substructure

Precast Elevated Bridge

Power Plant-Turbine Tower

Nuclear Power Plant-Intake

4

APPLICATIONS

5 GROUTING OPERATION: ACCESSORIES & MATERIALS

ITEM	DESCRIPTION
SS Mortar®	SS Mortar
Grout Pump	Manual/Electric/Air Operated
Handy Pump	Use as a backup in case of power outage
Grout Hose	For grout pump
Stopper with Indicator (SWI)	At Grout Outlet ports
Self-Sealing Valve (SSV)	At Grout Inlet ports
Nozzle	Use a nozzle to fit into Self-Sealing Valve

6 GROUT MIXING: TOOLS & EQUIPMENT

ITEM	DESCRIPTION
Mixing Bucket	Use 5 gallon（19 liters） steel pail. Avoid using plastic bucket.
Measuring Pail	For measuring 1 gallon (3.785 liters) of water
Scale	For measuring the correct weight of water (use as an alternative)
Electric Drill	(≥ 7 amp, 500-1300 RPM)
Mixing Paddle	NMB paddle
Stopwatch	Timing the required mixing time
Rubber/Latex Glove	
Cutter	To open SS Mortar
Protection Glasses	
Protection Mask	
Sponge	
Portable Heater	Use during winter as necessary

7

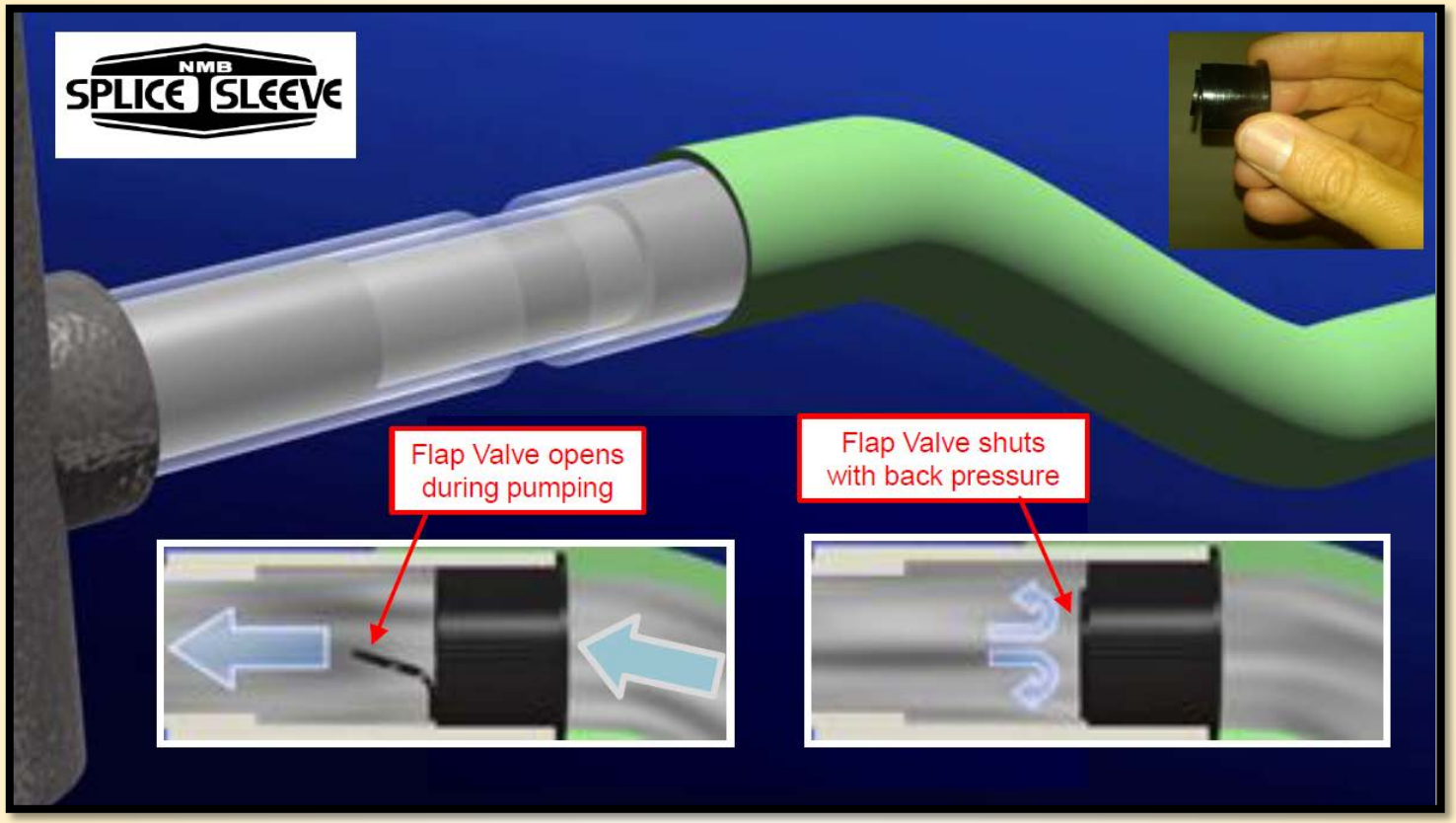
GROUT TESTING AND CUBE SPECIMENS: TOOLS & EQUIPMENT

ITEM	DESCRIPTION
Measuring Cup	2 pint (0.95 liters). Use for pouring mixed grout into flow cylinder and cubic molds
Thermometer	Measure temperature of air, water, and materials
Flow Table	For consistency test. 13.39” x 13.39” x 0.79” (340 x 340 x 20 mm)
Flow Cylinder	2” dia. x 4” high
Tape Measure	To measure the diameter of the puddle for consistency test
Angle Adjuster	For leveling the flow table as necessary
Leveler	To check the leveling of flow table
Spatula/Cement Knife	For removing excess grout during consistency and compressive strength tests
Tamper/Rubber Stick	For tamping grout during compressive strength test
Mallet/Wooden Hammer	For tapping the mold during compressive strength test
2” Triple (Brass or Steel) Cube mold	For assembling specimens for compressive strength test
Curing Box	For curing specimens for compressive strength test

GROUT TESTING AND CUBE SPECIMENS: TOOLS & EQUIPMENT

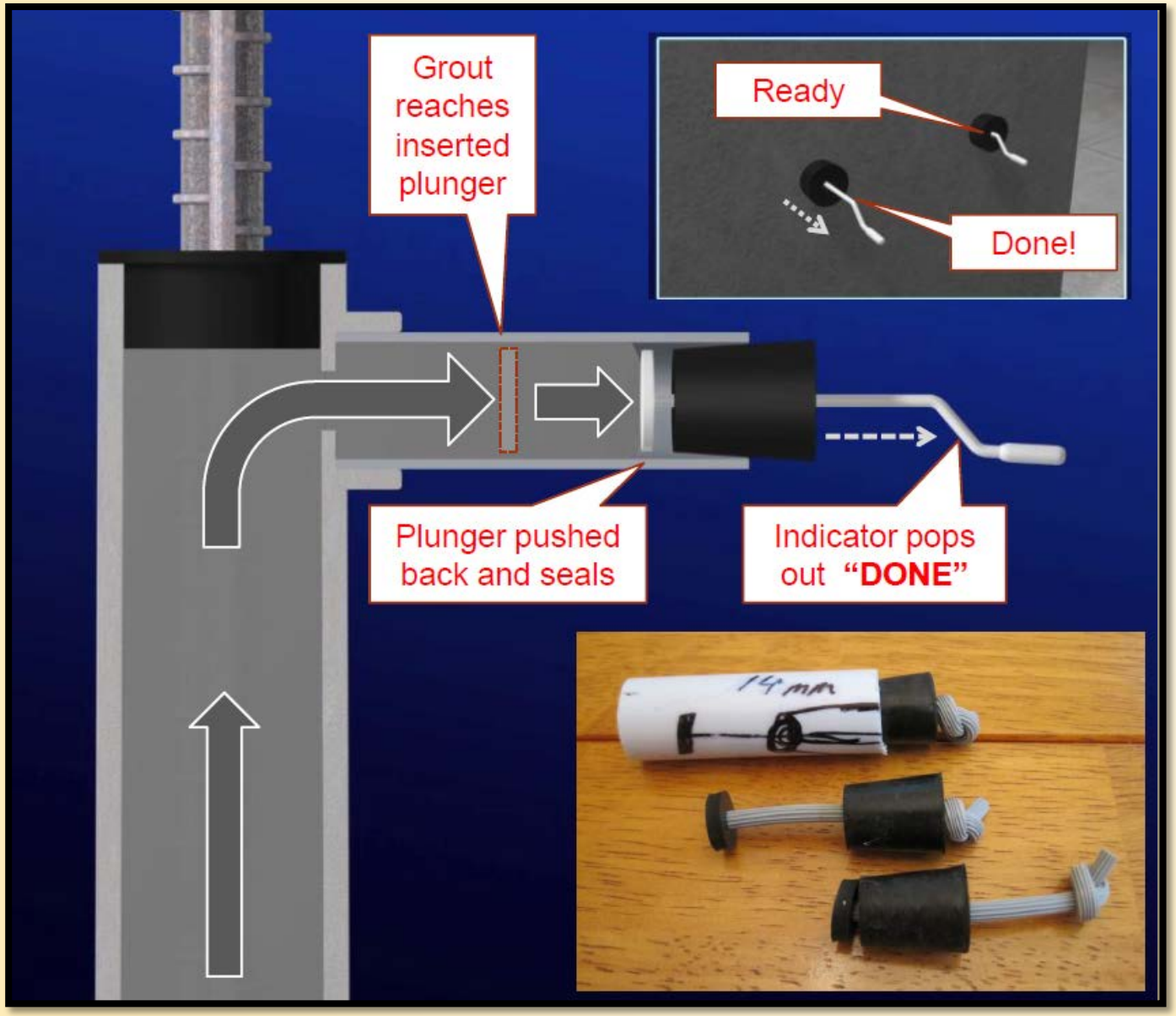
ITEM	DESCRIPTION
Water Supply	
Electric Power Supply	
Cleaning Tools	
Equipment for saturation	For sleeves and joint area
Air Compressor	For passage inspection
Electrical Tape	For securing grout tubes to the sleeve ports
Flashlight or Spotlight	For passage and grouting inspection
Steel Rod	For passage inspection and trouble-shooting
Sledge Hammer	For passage inspection and trouble-shooting

9 WORKING MECHANISM OF SELF-SEALING VALVE



- ✓ **Inserts into PVC grout inlet tube.**
- ✓ **Flap opens while pumping, then closes when grouting stops, preventing backflow and automatically sealing off the tube.**
- ✓ **Once grout stiffens, remove, clean and reuse.**
- ✓ **Saves time with plugs and prevents spills, waste and cleanup.**
- ✓ **It is recommended to start pumping slowly, especially while using self-sealing valve to avoid clogging, which subsequently can be increased a little bit once a smooth grout flow is confirmed.**

10 WORKING MECHANISM OF STOPPER WITH INDICATOR



- **It allows air and water to pass but when solid grout arrives it pushes the plunger back against the Stopper sealing off the tube automatically.**

- **Once grout stiffens, remove - clean – reuse.**

- **Saves time, catching cups & plugs, prevents spills & cleanup.**

- **Combined with the Self Sealing Valve, one person can grout.**

MIXER PADDLES

NOT RECOMMENDED

Cheater-Beater

Paint Paddle M525

Quik Mix M819

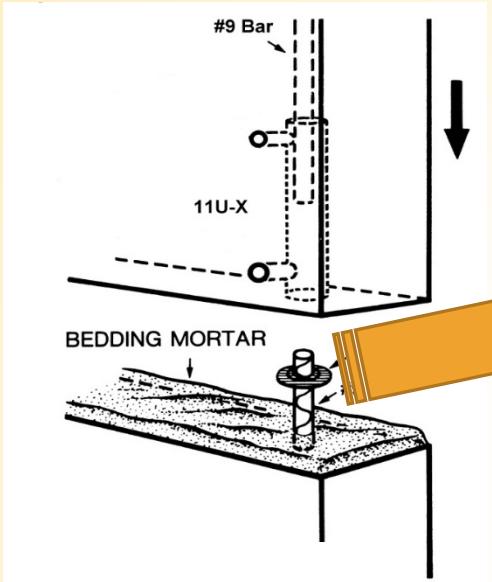
RECOMMENDED

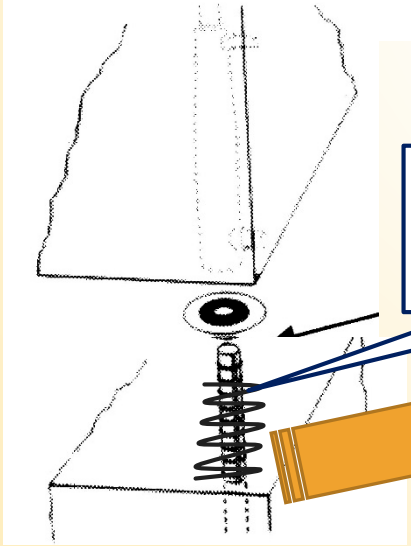
Jiffler

Cross Blade

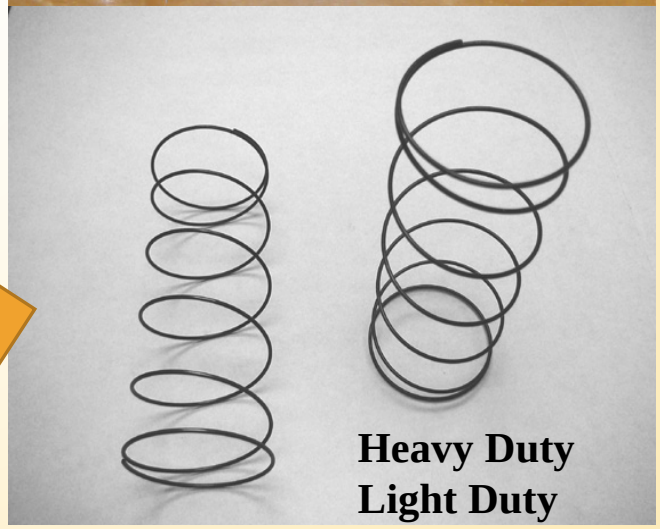
NMB Paddle

ACCESSORIES FOR ERECTION





Coil Spring supports the Grout Washer



TO PREVENT BEDDING MORTAR GETTING INTO THE SPLICE SLEEVE

OUTLINE OF GROUTING OPERATION

A. • Work schedule

B. • Assign a number to each sleeve

C. • Inspection of sleeves through grout holes

D. • Procure electricity and water for mixing

E. • Procure required quantity of SS Mortar

F. • Grout sampling and testing for quality control

G. • Grouting operation of Sleeves

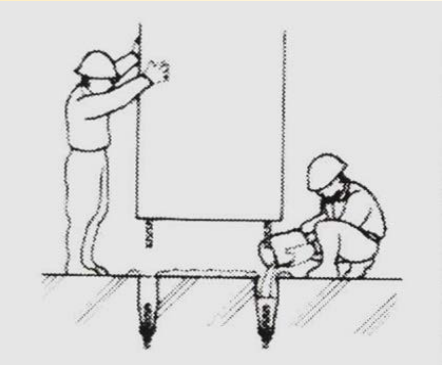
H. • Cleaning

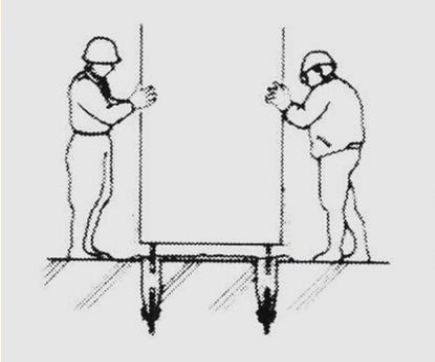
I. • Record keeping

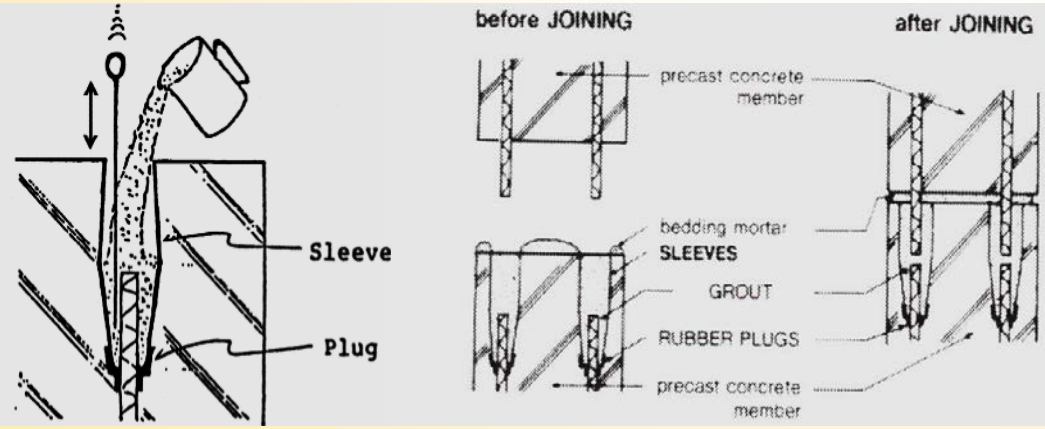
14 GROUTING METHODS FOR NMB SPLICE-SLEEVES

PRE-GROUTING METHOD

The NMB Splice-Sleeve® is located at the top of the lower precast member to be spliced. The grout is gravity fed into the Splice-Sleeve and the upper member with projecting rebar is erected into position.





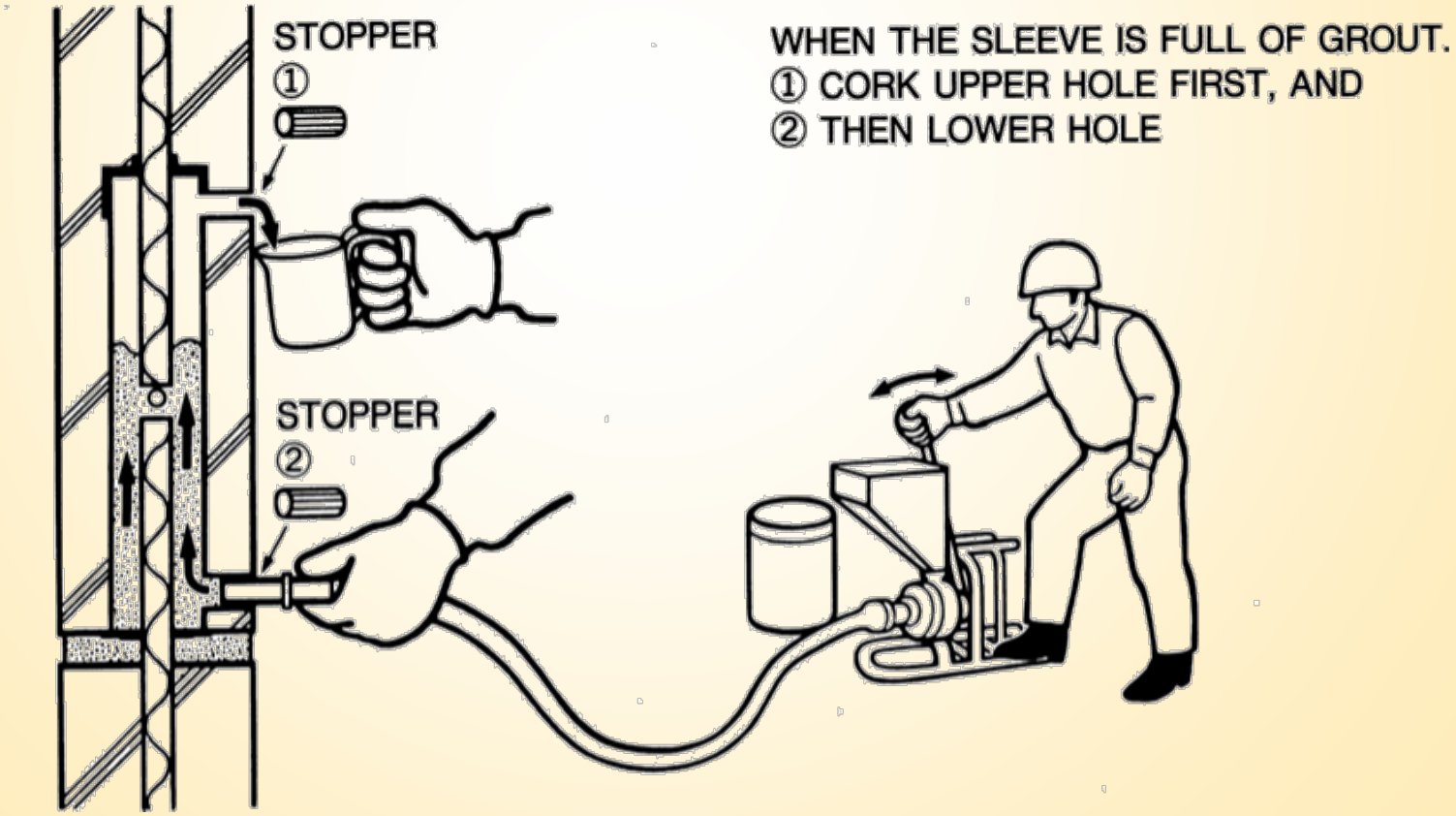


- Pour or pump SS Mortar mixed into the wide end opening of the sleeves.
- Rod with a small diameter wire to remove air in the grout.
- Fill sleeves before placing bedding grout to prevent the grout accidentally dropped in the sleeves.
- NOTE: remember that once filled, you have 40 minutes to set the precast. Best if precast is dry fitted to check all fits before filling.

GROUTING METHODS FOR NMB SPLICE-SLEEVES

POST-GROUTING METHOD

The NMB Splice-Sleeve® is located in the bottom of the upper member with reinforcing bar projecting out of the top of the lower member. Following the placement of the upper member, grouting is achieve by low pressure pumping



PREPARE DAILY WORK SCHEDULE/MATERIALS

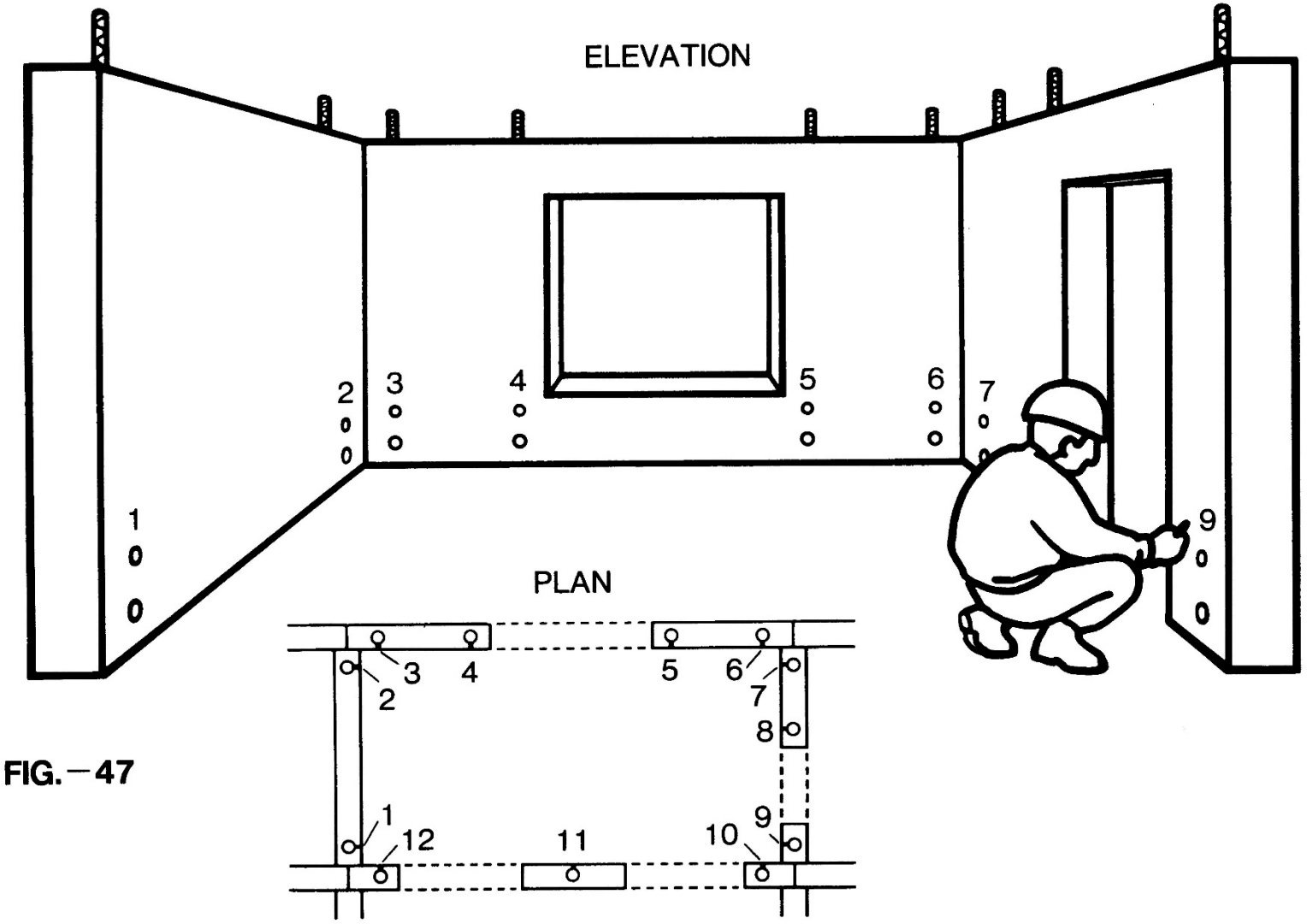
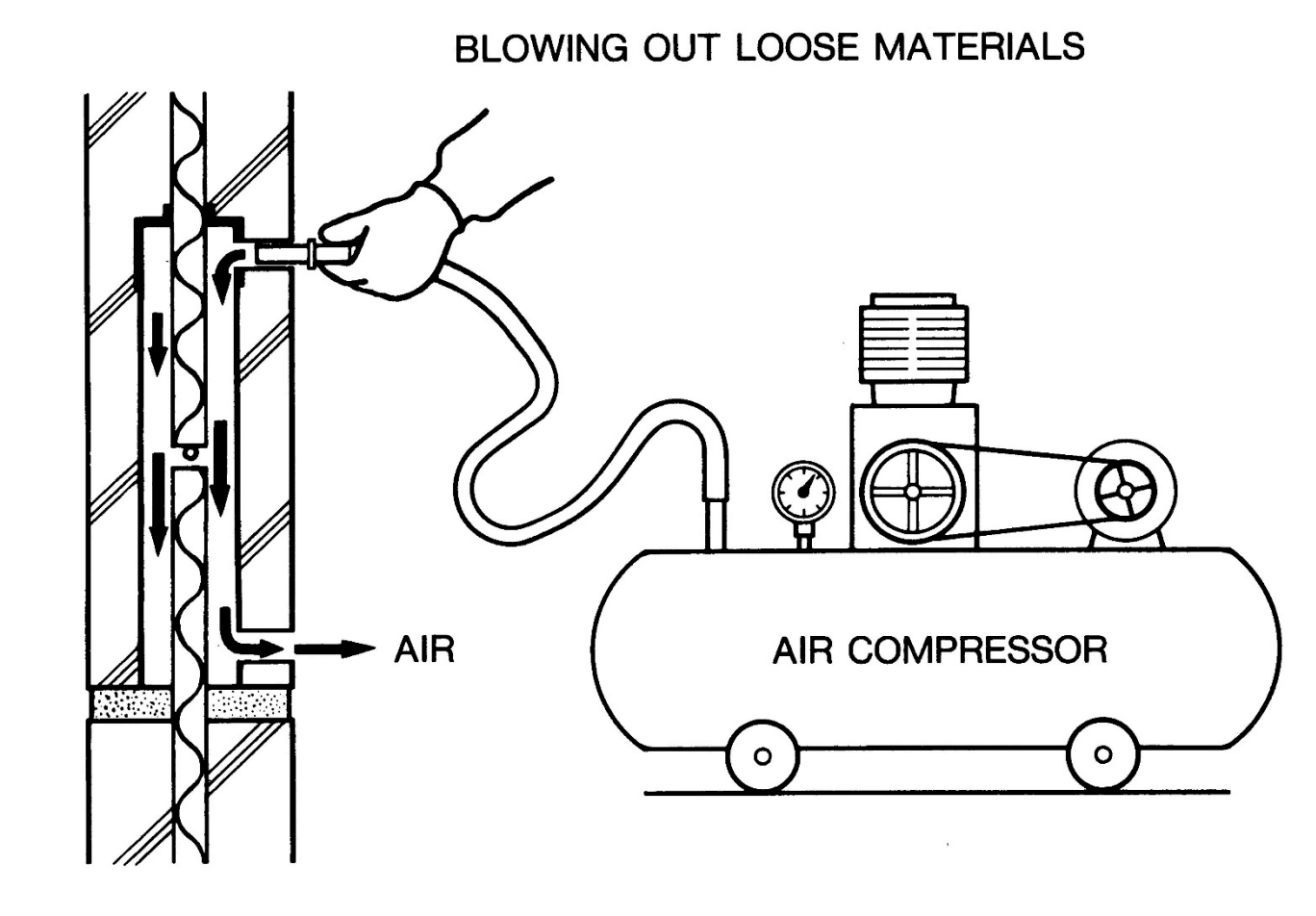


FIG.—47

INSPECTION OF SLEEVES PRIOR GROUTING



BLOW out loose materials inside sleeves

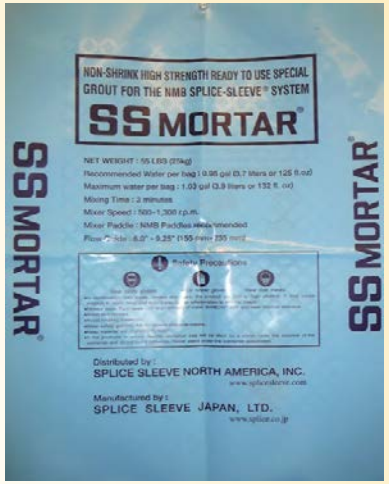
- Water may also be used to flush out sleeves from top to bottom.

SS MORTAR REQUIREMENT FOR SLEEVES

REBAR Size		Splice-Sleeve	SS Mortar		5" PVC Tubes + 15% overage	
U.S.	Metric	Model	lb/sleeve	Sleeves/Bag	lb/sleeve	Sleeves/Bag
#5	16 mm	5 U-X	0.94	**58.8**	1.26	**40.2**
#6	20 mm	6 U-X	1.31	**42.0**	1.76	**30.7**
#7	22 mm	7 U-X	2.06	**26.7**	2.65	**20.7**
#8	25 mm	8 U-X	2.70	**20.4**	3.46	**16.2**
#9	28 mm	9 U-X	3.20	**17.2**	3.95	**13.8**
#10	32 mm	10 U-X	4.01	**13.7**	4.94	**11.2**
#11	35 mm	11 U-X	5.01	**11.0**	6.02	**9.1**
#11	35 mm	SNX11	4.91	**11.2**	6.99	**9.3**
#11	35 mm	A11W	6.07	**9.1**	7.74	**7.6**
#14	40 mm	14 U-X	7.67	**7.2**	9.19	**6.0**
#18	57 mm	18 U	22.62	**2.4**	25.31	**2.1**

If pumping **grout tubes add** a little more - see example on chart. When **"upsizing" add 20%** for each rebar size.

An additional overage of **15%** is recommended to provide for typical waste and field loss while continuously pumping large numbers of sleeves.


NON-SHRINK HIGH STRENGTH READY TO USE SPECIAL GROUT FOR THE NMB SPLICE-SLEEVE® SYSTEM
SS MORTAR®
SS MORTAR®
SS MORTAR®
Distributed by :
SPLICE SLEEVE NORTH AMERICA, INC.
Manufactured by :
SPLICE SLEEVE JAPAN, LTD.

SS Mortar® (Grout) manufactured by Splice Sleeve Japan, Ltd. is a special cementicious **non-metallic** filler grout developed for the NMB Splice-Sleeve System.

SS Mortar® (Grout) is packaged in **55-lbs (25-kg)** moisture resistant bags.

Achieves:
≥14,000 psi Compressive Strength @ 28 day
≥ 4,000 psi in less than 24 hours at 68°F (20°C)

Mixing water: **1 gallon**

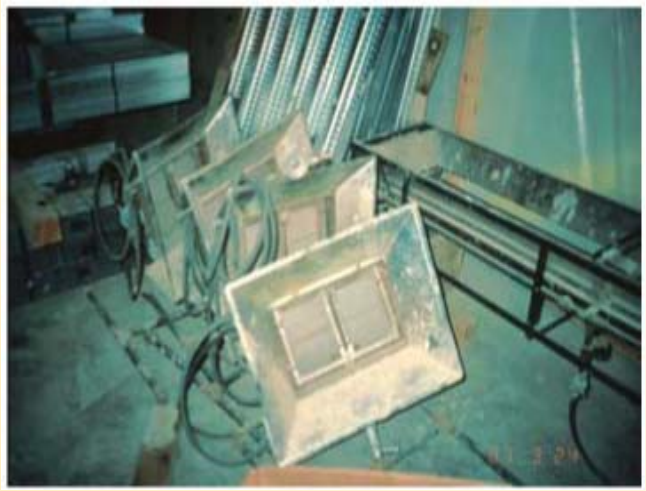
Mixing time: **2 ½ minutes** minimum

GROUTING CONDITIONS

- Store SS MORTAR in a cool dry place

  50°F(10°C) - 80°F(27°C)

- Cold Weather: Heat and keep above 40°F(4.4°C) inside the sleeves and after grouted. Best curing temperature at 60°F(15°C). Use Radian Heater, Electric Blanket, Hydronic Hose
- Hot Weather: Use chilled mixing water to keep the mixed grout temp below 80°F(27°C)
- Do not perform grouting when no shelter from rain or snow, under below 40°F, **and/or harmful vibration/impacts are expected throughout curing time.**



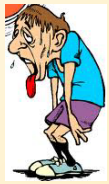
SS MORTAR GROUT PERFORMANCE DATA

SS Mortar® (Grout) - Fresh Mortar Test Results

WATER VOLUME	MIX TEMP	CURING TEMP	SET TIME HR-MIN		FLOW GUIDE	BLEEDING %
			INITIAL	FINAL		
0.98 gal (3.7 liters)	68 (20)	41°F (5°C)	9 hr. 31 min.	13 hr. 35 min.	6 1/4" (160 mm)	0.00%
		68°F (20°C)	4 hr. 18 min.	5 hr. 55 min.	6 5/8" (170 mm)	0.00%
		86°F (30°C)	2 hr. 23 min.	3 hr. 20 min.	6 1/2" (165 mm)	0.00%

Nonmetallic, SS Mortar® can be used in when the **surrounding concrete and the sleeve temperature** is between

35°F (2°C) up to 140°F (60°C).



Freezing grout before it is above 1,500 psi will deplete strength.

The grout itself should be **mixed and pumped** between **50°F (10°C) and 95°F (35°C).**

SS MORTAR GROUT PERFORMANCE DATA

CURING TEMPERATURE	COMPRESSIVE STRENGTH, PSI (MPA)					
	12 HRS.	18 HRS.	1 DAY	3 DAYS	7 DAYS	28 days
41 (5)	----	834 (6)	1,869 (13)	5,823 (40)	8,871 (61)	13,860 (96)
50 (10)	410 (3)	1,869 (13)	2,905 (20)	6,858 (47)	9,907 (68)	14,895 (103)
68 (20)	1,869 (13)	3,328 (23)	4,364 (30)	8,317 (57)	11,366 (78)	16,354 (113)
z86 (30)	2,905 (20)	4,364 (30)	5,399 (37)	9,352 (64)	12,401 (86)	17,389 (120)
104 (40)	3,708 (26)	5,167 (36)	6,202 (43)	10,155 (70)	13,204 (91)	18,192 (125)

3,000 psi = 100% F_y = Specified Yield = 60ksi (ASTM Grade 60 rebar)

4,000 psi = conservatively above F_y allowing for variation in cube versus sleeve curing temperatures.
Typically specified by EORs for removal of bracing and continued erection (typical structures)

6,500 psi = 125% F_y (75ksi) = **ACI Type 1** and **AASHTO**

9,500 psi = 100% Specified Tensile (A615) * (90-ksi) = 150% F_y = **ACI Type 2**
*ASTM Grade 60, 615 rebar Fu = 90-ksi (706 rebar F_u = 80-ksi)

FRESHNESS" BAG LIFE OF NON-METALLIC SS MORTAR

Nissco SS Mortar should be stored in moderate/cool and dry conditions.
50°F – 80°F (10°C – 27°C)

It has a "freshness" bag life of one (1) year.

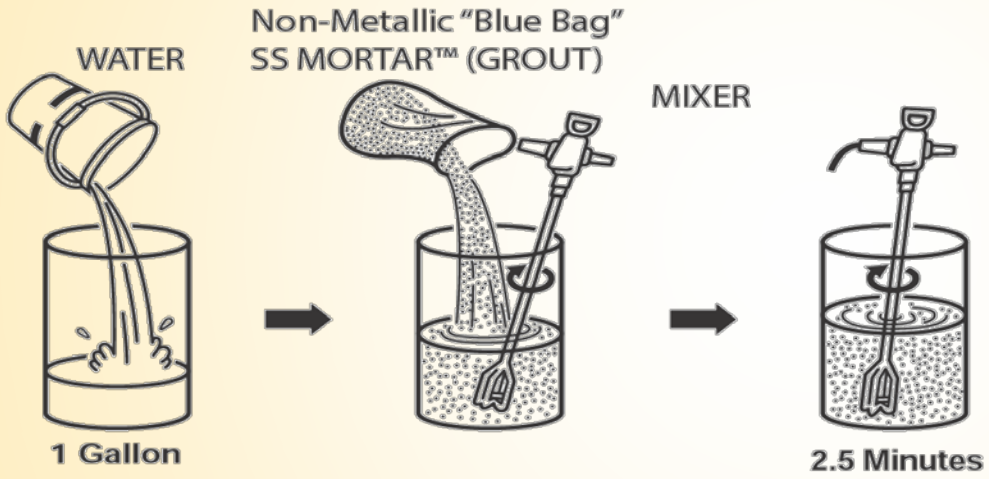
Bags have a date stamp on the top using letters for the year then month then numbers for the day

Year	11	12	13	14	15	16	17	18	19	20		
	A	B	C	D	E	F	G	H	I	J		
Month	1	2	3	4	5	6	7	8	9	10	11	12
	A	B	C	D	E	F	G	H	I	J	K	L
Day	As a number from 1 to 31											

CF 25: 13 - 06 - 25 = June 25, 2013

MIXING OF SS MORTAR

- SS Mortar® is a ready-to-use formulation requiring only the proper amount of water, which is suggested at 1.00 gal. = 3.8 liters per bag. The maximum water is 1.03 gal. = 3.9 liters. Do not use admixtures. The field consistency should be between 6.0" minimum and 9.25" maximum



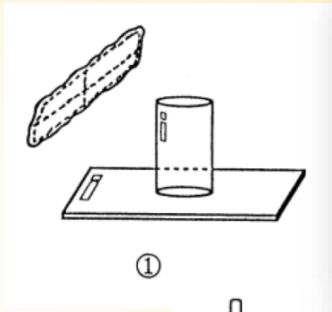
- Use a full bag unit for each batch. Do not use SS Mortar® (Grout) if the package is damaged. SS Mortar® (Grout) has a shelf life of approximately 12 months

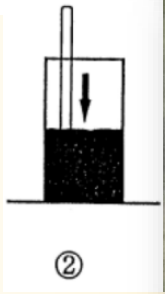
SOME DONT'S DURING MIXING OF SS MORTAR

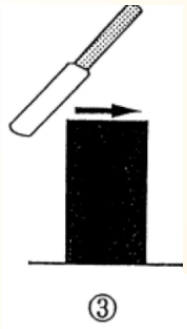
- Do not mix by hand.
- Do not add cement, sand, aggregate or admixtures.
- Do not add more water than specified, nor re-mix.
- Do not use partial bag(Use full bag each time)
- Do not use if the bag is damaged.
- Do not use a grout other than SS Mortar.
- Do not use SS Mortar beyond one year shelf life.
- Do not leave the mixed grout in the pump.

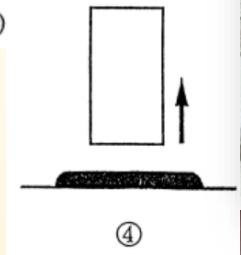
FLOW/CONSISTENCY MEASUREMENT OF SS MORTAR

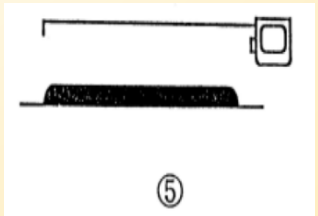
- **Wipe the Flow Table surface with wet rag.**
- **Pour SS Mortar into Flow Cylinder.**
- **Level the surface at the rim with cement knife.**
- **Lift Cylinder slowly vertically.**
- **Measure the diameter in two ways. The diameter is be 6” – 9 ¼” (160mm - 230mm).**











COUNTER MEASURES INCASE FLOW/CONSISTENCY TEST OF SS MORTAR IS NOT WITHIN RANGE

SS Mortar Grout Consistency/ Flow Test

- **Failed**
  - **Consistency less than 6”**
    - **Remix**
      - Put all mixed grout back into the pail.
      - Measure 0.1 or 0.2 liter of water accurately and add to mixed grout.
      - Re-mix grout for 30-60 seconds.
    - **Re-Measure the Consistency of SS Mortar**
      - **Fail: Dispose and Start Mixing a new batch of SS Mortar**
      - **Pass: Use Mixed Grout for Grouting of NMB Splice-Sleeves.**
  - **Consistency more than 9.25”**
    - **Discard the mix and start mixing a new batch of SS Mortar**
- **Passed (Consistency within 6” and 9.25”)**
  - **Use Mixed Grout for Grouting of NMB Splice-Sleeves**

Note:
Dispose mixed grout in the following conditions:

① **More than 30 minutes passed after the completion of the 1st mixing.**

① **The total amount of mixing water exceeds 3.9 liter (1.03 gallon) per 25 kg bag.**

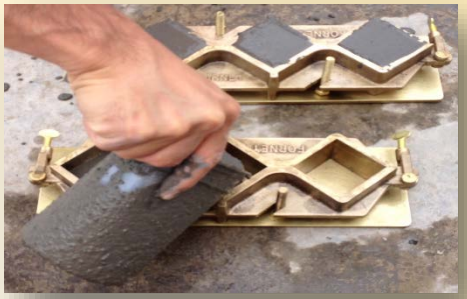
PREPARATION/SAMPLING OF GROUT CUBE SPECIMENS

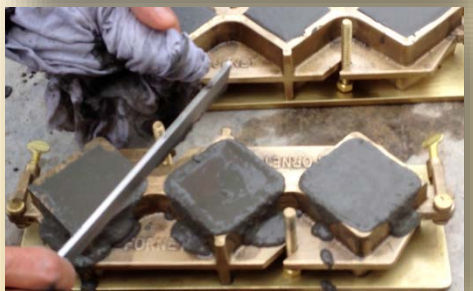
- Grout is poured into the mold in two equal layers, each layer being tamped eight (8) times with the tamper and compacted by tapping the sides of the mold several times with a wooden hammer.

- Remove excess grout with trowel and clean top edge of mold very carefully.

- Cover the molds with a heavy plate and wet cloth, then place the specimens undisturbed for at least 24 hours in a curing box.

- Strip the cubes following day, mark to identify on top trowel surface and cure them in lime water for 28 days or until tested.





COMPRESSIVE STRENGTH TESTING OF GROUT CUBE SPECIMENS

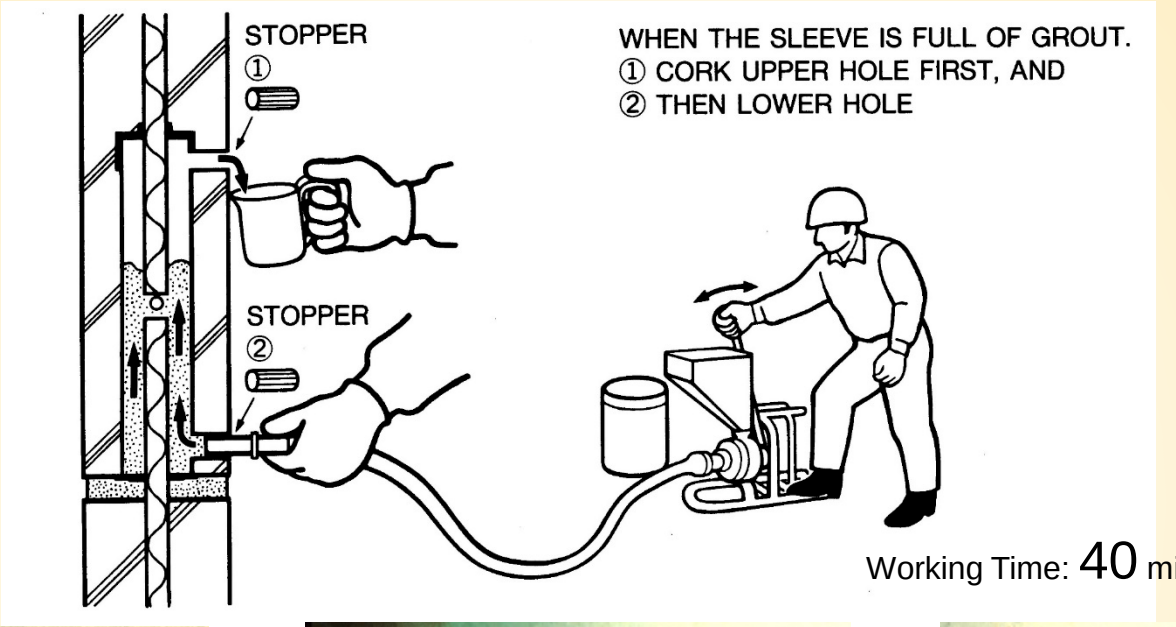
- 2” (5 cm) Cube compressive test will be conducted according to ASTM C109-80

Attention: ***Place the cube on its side other than the face levelled during preparation. The cube must be placed at the dead center of compressive testing machine***

GROUTING OF NMB SPLICE-SLEEVES

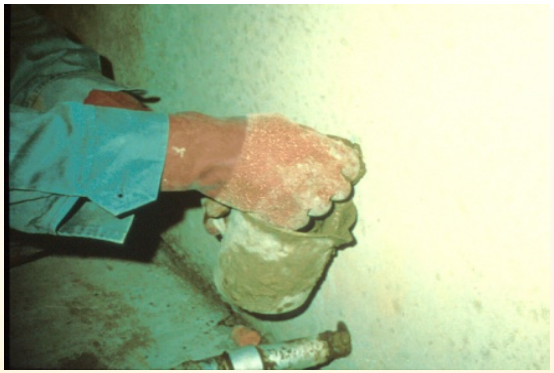
1. First, saturate the pump and grout hose with water to lubricate inside.
2. Pour the mixed grout into the pump hopper and operate the pump to push out the slurry from the hose.
3. After confirming a solid stream of grout coming out of the nozzle, stop pumping and insert the nozzle into the sleeve grout inlet.
4. Keep pumping the grout slowly until a solid flow of grout can be seen from the outlet hole.
5. Catch the overflow in a cup and seal the outlet with stopper.
6. Then, withdraw the nozzle and seal the inlet hole with the stopper.

GROUTING OF NMB SPLICE-SLEEVES



Working Time: 40 minutes

A: Pump grout into sleeve though the inlet port continuously and slowly



B: Catch the overflow in a cup and seal the outlet hole with a rubber stopper.

C: **W**ithdraw the nozzle from the inlet hole and seal it with a rubber stopper.

CHECK-LIST: PRIOR GROUTING

NO.	ITEM	TESTING /INSPECTION METHOD	CRITERIA
1	Material inspection	Check for the Lot Number printed on the bag to confirm the bag life, which should be within one year period to the date of grouting	Make sure that SS Mortar did not expire the bag life of one year
2	Rain water seepage	Visual inspection on SS Mortar	Make sure that no rain water is inside the material
3	Sleeve temperature	Measure the temperature with a thermometer	Should be between 35 ～140°F (2～60°C)
4	Location & quantity of sleeves	Check the specification/drawings	Make sure that the location and quantity match the specification/drawings
5	Dowel embedment length	Check for proper dowel embedment length	Make sure that the embedment length of dowel is as per the requirement in the User's Manual
6	Inside sleeve	Visual inspection	Make sure that sleeve inside is clean and free from loose materials
7	Sleeve passage	Check the sleeve by blowing out air through the ports or check for sound by tapping the port, for confirmation of a clear passage	Make sure that there is a clear passage from the inlet to outlet ports

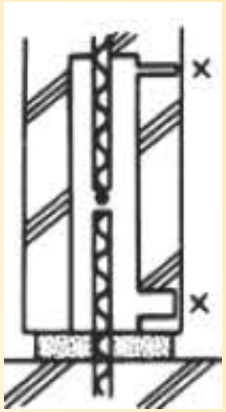
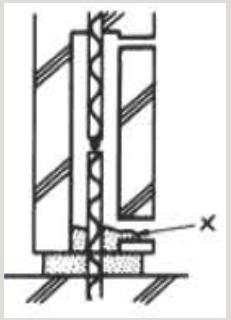
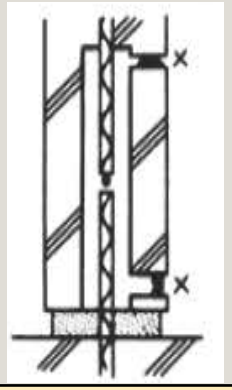
CHECK-LIST: DURING & AFTER GROUTING

NO.	ITEM	TESTING /INSPECTION METHOD	CRITERIA
8	Mixing water	Confirm as per the User's Manual	1 gallon /55 lbs. bag (0.95～1.03 gallon/55 lbs. bag)
9	Mixing temperature	Confirm as per the User's Manual	50～95°F (10～35°C)
10	Mixing time	Confirm as per the User's Manual	2-1/2 minutes
11	Grout working time	Confirm as per the User's Manual	Within 40 minutes
12	Consistency test	Confirm as per the User's Manual	The consistency measurement should fall in the range of 6" to 9-1/4".
13	Inspection at grouting (Pre- Grout)	Confirm as per the User's Manual	Make sure that all the sleeves were totally filled with SS Mortar. Make sure that the bedding mortar does not get inside the sleeves
14	Inspection at grouting (Post- Grout)	Confirm as per the User's Manual	Make sure that all the sleeves were totally grouted from inside and solid grout comes out from the outlet port
15	Inspection after grouting	Confirm as per the User's Manual	Reconfirm that all sleeves and joint areas are completely grouted by using grouting report as a check sheet

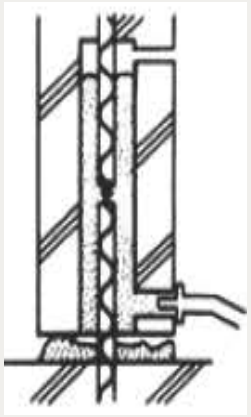
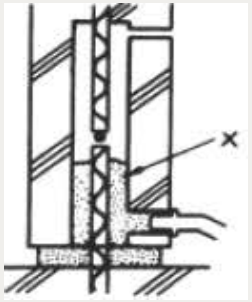
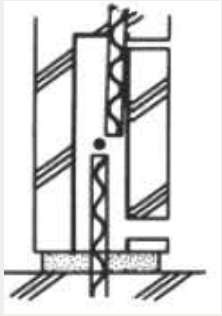
GROUTING REPORT SAMPLE

REPORT OF GROUT WORK - INSPECTION SHEET					
Project			Temperature Readings	Ambient	
Location				Dry Grout	
Date of Grouting				Mixing Water	
Date of Inspection				Grout as Mixed	
Report by			SS Mortar Lot No.		
Approved by			Flow Measurement		
NMb Sleeve Size	Quantity	Plan	Grouted	Balance	MEMO
5U-X	10	10	10	0	OK
6U-X	12	12	10	2	Ports Missing

TROUBLE SHOOTING

Inlet/outlet ports do not reach the surface	1. Check and mark the position of the ports according to the drawings. 2. Chip out the concrete at the marked positions to find the embedded ports. 3. Blow out the ports with the air compressors or water and confirm that there is a clear passage from the inlet to outlet port.	
Due to omission of washers, the inlet port is clogged with bedding mortar from the joint	1. Insert a steel rod into the ports and hammer it to clear the port. 2. Repeat step 3 of Item 1.	
Inlet and/or outlet port is clogged with concrete debris etc. or plastic Hole Seals (sealing caps)	For debris etc.: Insert a steel rod into the ports and hammer it to clear the port. For Hole seals: 1. Use a hooked rod to scrape seals out of the ports. 2. Repeat step 3 of Item 1.	

TROUBLE SHOOTING

Leakage during pumping of grout from the joint due to incomplete mortar bedding	1. Seal the joint with rags, polyurethane, mortar, etc.	
	2 Clean the inside of the sleeve with water. (Preferably high pressure).	
	3. Confirm a clear passage by blowing with air.	
	4. Re-grout.	
6. Clogging has occurred inside the sleeve such as at point marked during pumping operation	1. Clean the inside with high pressure water	
	2. After confirming a clear passage by blowing with air, start re-grouting at about half speed of the normal operation	
7. Rebar is too close to the outlet port, restricting grout flow	1. Insert heavy punch into outlet grout tube and strike with sledge hammer to reduce restriction	

OVERVIEW VIDEO OF GROUTING PROCESS

I 85 Bridge Construction using NMBs _ **Please click on the link to watch the video**

THANK YOU!!!

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